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The initial phase of the Brumfield Russian Architecture project, funded by a previous NEH grant and other sources, was a three-year digitization and cataloging project, scanning Prof. Brumfield's conventional slides and creating a hierarchically structured metadata set to describe the roughly 30,000 images that constitute the digital Brumfield Russian Architecture Collection.

The currently funded NEH Digital Humanities project is for the design and implementation of a web interface to make a substantial part of the Brumfield Collection available for study at various levels of sophistication in a form appropriate to both the nature of the material and the needs of the wide variety of users who will be consulting it. The interface envisaged here, as distinct from a data storage and retrieval system, involves an awareness of the nature of the particular data set and the potential for combination of its elements into information meaningful to a wide variety of potential users, especially but not exclusively those who are serious researchers as opposed to exploratory browsers. The Brumfield Collection Project has aimed from its outset to take advantage of the evolution over recent years of both metadata structures and presentation technologies.

The images of the Brumfield Collection were cataloged using a metadata set (devised for this project, and still to some extent evolving as the collection grows) that describes the most important characteristics of Russian buildings. Metadata of this kind serve a basic archival purpose, enabling the partial retrieval of stored data based on certain characteristics rather than others. Current best practices for metadata structures using XML-based schemas, such as the Metadata Encoding and Transmission Standard (METS), enable substantial advances in the presentation of both images and metadata, and in the eventual usability of interfaces. The use of structured metadata schemas for modeling the complex data relationships typically found in architectural collections has the advantage of providing a standardized, documented format that can be transferred to any suite of delivery and presentation mechanisms. It also makes it possible to minimize redundancies in cataloging, and allows clearer relationships to be described between the architectural components, regardless of the eventual presentation format. The Visual Resources Association (VRA) is developing a set of best practices for describing cultural objects (such as architectural entities). These guidelines, known as CCO and based on the work of Murtha Baca et al. (*Cataloging Cultural Objects: A Guide To Describing Cultural Works And Their Images*, Chicago: American Library Association, 2006), was extensively consulted during the metadata design and recording processes for this project. The Brumfield Collection Project employed a metadata standard that allows capture of the many subtleties and factual details that are crucial for accurate and sophisticated documentation of architectural objects. The METS framework was used to structure the data hierarchically, while CCO guidelines are employed for cataloging procedures. The CCO guidelines provide appropriate strategies for cataloging cultural objects, such as those contained in the Brumfield images. Descriptive metadata has been created using the Visual Resources Association (VRA) schema for cultural objects, since it has some elements that are more appropriate to the Brumfield collection.

The structure for the Brumfield metadata, which reflects multiple images of most of the architectural entities in the collection, was from the outset envisaged as hierarchical,

based on the degree of generality of the view represented by each photographic image of the same entity. The photographs may be of panoramic scenes placing particular buildings in their natural or architectural environments, complexes composed of several buildings, individual buildings viewed from the exterior or the interior, substructures of buildings, or details of construction and decoration. The metadata reflects this structure, making it possible to access the information it contains in ways that are not strictly sequential, and go beyond display based on multiple-criteria searches. Ideally, a display based on browsing, look-up or a search for one or more criteria would be followed by an exploration of related images at different levels of the hierarchy of generality.

We have produced a draft version of a Brumfield Collection interface that fulfills some, but not all, of our objectives. The application as it stands consists of a relational database that contains the metadata for the Collection, a search facility that allows keyword, subject, and date searching of the metadata, a browse facility that generates a tree display of the building hierarchy to which a given image belongs and allows the user to navigate that hierarchy, and a thesaurus facility that assists in building queries using the Getty Art and Architecture Thesaurus¹ (AAT) controlled vocabulary. The interface can be explored at <http://digital.lib.washington.edu/brumfield/>

A search, whether keyword or restricted to a particular field, produces a result set displayed as a carousel² of thumbnail images rendered in a JavaScript Document Object Model (DOM) document. The jQuery toolkit³ is used to manipulate the DOM. Clicking on an image will generate a tree display of the building hierarchy to which that image belongs. This display is generated by the JavaScript InfoVis Toolkit⁴ as a 'Hypertree,' a Hyperbolic Tree/Graph visualization [Figures 1-2].

The display can be navigated to display each work and sub-work of the hierarchy. Right clicking (control click) on a centered node in this tree will display a carousel of all the images associated with that node [Figure 3]. The user may also display the metadata associated with the work [Figure 4]. Clicking on one of the images in the carousel will display the full sized image in a modal dialog⁵ [Figure 5]. The metadata for a given image can also be displayed [Figure 6].

The thesaurus facility consists of an expanding tree display of the subject terms used in the Brumfield database that are drawn from the Getty Art and Architecture Thesaurus. This display is generated by the InfoVis Toolkit as a 'Spacetree' [Figure 7]. The tree display can be browsed, and right clicking on any term displayed as an ellipse (to indicate its presence in the database) will add that term to a subject-term field of the search form. Currently, the subset of thesaurus data present in the database is extracted in a batch process and used to create a JavaScript Object Notation (JSON) object; a more scalable approach would be to create the JSON objects at runtime depending on the portion of the hierarchy being navigated at the time.

The intent of this project was to develop an interface that fully exposed the hierarchy encoded in the metadata, and allowed the user to explore those relationships. In this, we were not successful. The newness in practice of the metadata scheme described above generated some problems, as the library cataloging personnel and the assistants working

under their supervision sometimes had difficulty when creating the metadata for the Brumfield images required departures from conventional library cataloging procedures, and resulted in some inconsistencies.

There are also redundancies and omissions in the metadata in its present state. During implementation, we discovered that the hierarchies varied in their completeness. In some cases, the metadata specialists were not able to identify an element with sufficient accuracy to place it in a hierarchy. In other cases, appropriate subject terms were not assigned. Finally, and not unexpectedly, there were simply lacunae in the corpus; there may have been photographs of several related buildings but no photograph of their common parent element (e.g., a street or a campus).

The relatively consistent and widespread use of the Getty Art and Architecture Thesaurus of terms within the Brumfield database is one of its greatest strengths. In the translation of the original VRACore schema to a relational database schema, an attempt was made at a kind of faceted structure by the provision of separate tables like Subject, Creator, Style-Period, Technique, and Materials. In each of these tables, the AAT is by far the most frequently used vocabulary. The AAT data is itself both faceted and hierarchical, and we attempted to use the syndetic structure of the thesaurus to supplement the relationships that were explicitly encoded in the Brumfield metadata. For example, a user who was interested in the use of building materials made from clay or clay derivatives could use the thesaurus to identify "brick" and "ceramic tile" as clay products and then retrieve photographs illustrating the use of these materials. As the database is currently structured, however, it is impossible to make effective use of this feature.

The initial obstacle to making full use of the Getty terms in the interface was the fact that many of the terms used in the cataloging included parenthetical expressions to disambiguate their hierarchical antecedents. For example, the term "towers" appears twice in the AAT, once in the context of the "Built Environment" hierarchy, and again in the "Components" hierarchy. The metadata specialists disambiguated these two separate terms by the use of parentheses: "towers (single built works)", and "towers (building divisions)". The disambiguation provided by the parenthetical expression cannot easily be separated from the subject term, that is, the parenthetical expression is not always merely the term's hierarchical parent, making it impossible to match the subject strings in the metadata to the XML-encoded thesaurus. The only reliable way to distinguish between the two instances of "tower" and their location in the hierarchy would be to use the AAT's subject id number, but this datum was not used in the cataloging. This defect affects approximately 25% of the subject terms in the Brumfield database, rendering over 14,000 images irretrievable via the thesaurus term. A similar situation exists for the "creator," "styleperiod," "materials," and "techniques" metadata fields.

It became apparent that, without substantial revision and augmentation of the metadata, further development of the interface was not warranted and work was stopped. While we anticipated the need for some minor metadata work, wholesale refactoring and enhancement of the database was out of scope for the project and funds had not been requested for that purpose. The question then became, 1) how can we best expose this

collection to researchers given the current state of the metadata, and 2), what needs to be done to the database in order to support the kind of discovery and exploration articulated in the original proposal.

We have identified resources internal to the University that will allow us to import the existing metadata and associated images into ContentDM, a search and retrieval system built for image retrieval. Although ContentDM does not support the kind of hierarchical exploration envisioned in our proposal, it will provide access to the collection through conventional keyword and fielded searching techniques and for some uses, this will be adequate. We have used ContentDM for other image collections and are familiar with its Submission Information Package (SIP) format for importing metadata and images. Work has begun on a test load and, barring unforeseen problems, the full collection should be publicly available via ContentDM at <http://digital.lib.washington.edu/> in the first quarter of 2013.

Longer term, we still see value in the kind of interface we originally envisioned. We are seeking support within the University of Washington for a revision of the Brumfield database that will purge it of most errors and inconsistencies, augment the existing metadata, and make possible a fuller realization of the objectives described in the original proposal. At a minimum, in addition to correcting erroneous metadata, the following changes and additions to the database are needed:

- The "Subjects" table should be provided with an additional field: `gettyid`. The `gettyid` for each subject term used in the database should be determined and supplied. Similarly, other data from the AAT might be explicitly supplied within the subjects table; notably, `Parent_Subject_ID`, `Record_Type`, and `Facet_Code`. Alternatively, these could be derived from the AAT data at run-time, but only if we have the `gettyid`. Similar augmentation needs to be done for other tables that use the AAT vocabulary: "creator," "styleperiod," "materials," and "techniques".
- Terms drawn from other sources, e.g., Library of Congress Subject Headings, and, especially, terms coined by the Brumfield project for specific purposes (local), need to be integrated with the terms from the AAT. This can be done using the facet categories supplied by the AAT and would result in a coherent ontology that could be deployed to create a unified and intuitive browse interface, simplify the construction of database queries, and support the generation of linked open data.
- An effort must be made to assign subject terms to all the entries in the database, both Works and Images. There are still approximately 10,000 images and 200 works that require subject terms. The other tables drawing on AAT data are very sparsely populated. An effort must be made to supply creator, styleperiod, and materials data for all Work records in the database. As much as possible, these terms should be drawn from the AAT.

- The database needs to be normalized. This will aid in maintaining database integrity, ease of maintenance, and query formulation.

Nothing that is being done to expose this collection using ContentDM precludes further development along the lines we originally outlined. Assuming we can secure the needed resources, we intend to pursue that vision. In addition to the Content DM interface described above, we plan to make available in 2013 to a restricted set of trial users a testable version of the originally envisaged interface, with evanescent (i.e. appearing only on mouse-over) prompts and instructions to make it exploitable in practice. Our ultimate goal is to produce a version of the Brumfield Collection database and interface that can be integrated into the 'Semantic Web' and made part of a much broader array of shared resources on Russian architecture and the subjects associated with it.

A final but important point needs to be made about the Brumfield Collection interface and the future work involved in completing it: The Brumfield Collection is a 'work' in its own right. It is a reflection of the curiosity, interests, enthusiasm and vision of a particular scholar of Russian architecture, and the access he was able to obtain over several decades to the architectural heritage of a country that was in the relevant period partially closed to visitors from abroad. The interface will necessarily provide information not just about the world of Russian architecture, but about the collection as such, the achievement of a particular photographer in a certain set of historical and political circumstances over the last three decades of the Soviet Union and the first decades of post-Soviet Russia. Many of the inconsistencies in the data are due not to cataloging difficulties, but to choices made for a variety of reasons by Professor Brumfield. Respect for these choices ultimately takes precedence over an attempt to fulfill any particular schema or taxonomy of Russian architecture.

Figures

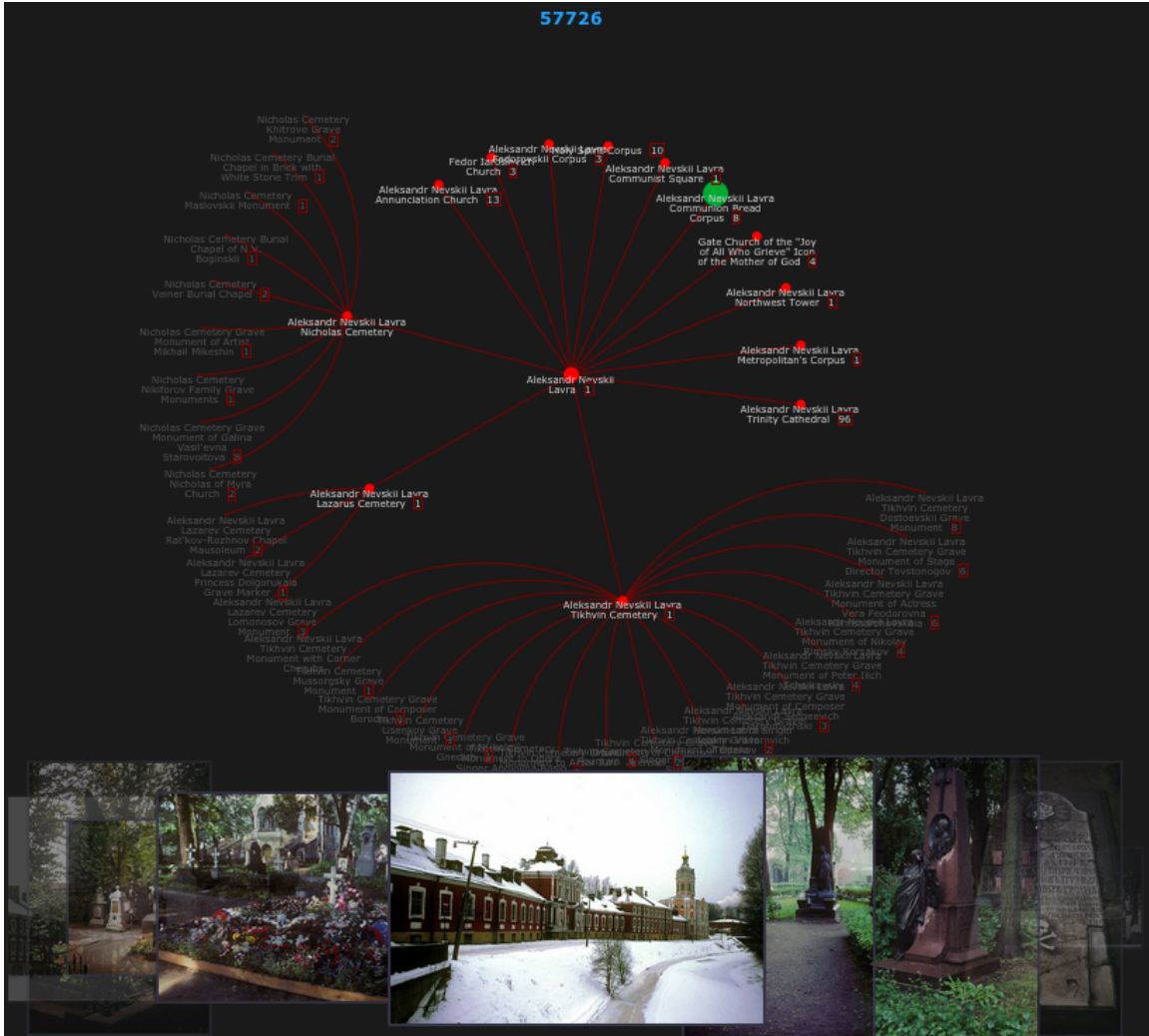


Figure 1: Result set for a string search on “Aleksandr Nevskii Lavra”, showing the carousel of images. The tree structure results from clicking on the image of the “Communion Bread Corpus”, the center image in the carousel. The green node indicates the location of the Communion Bread Corpus in the hierarchy.

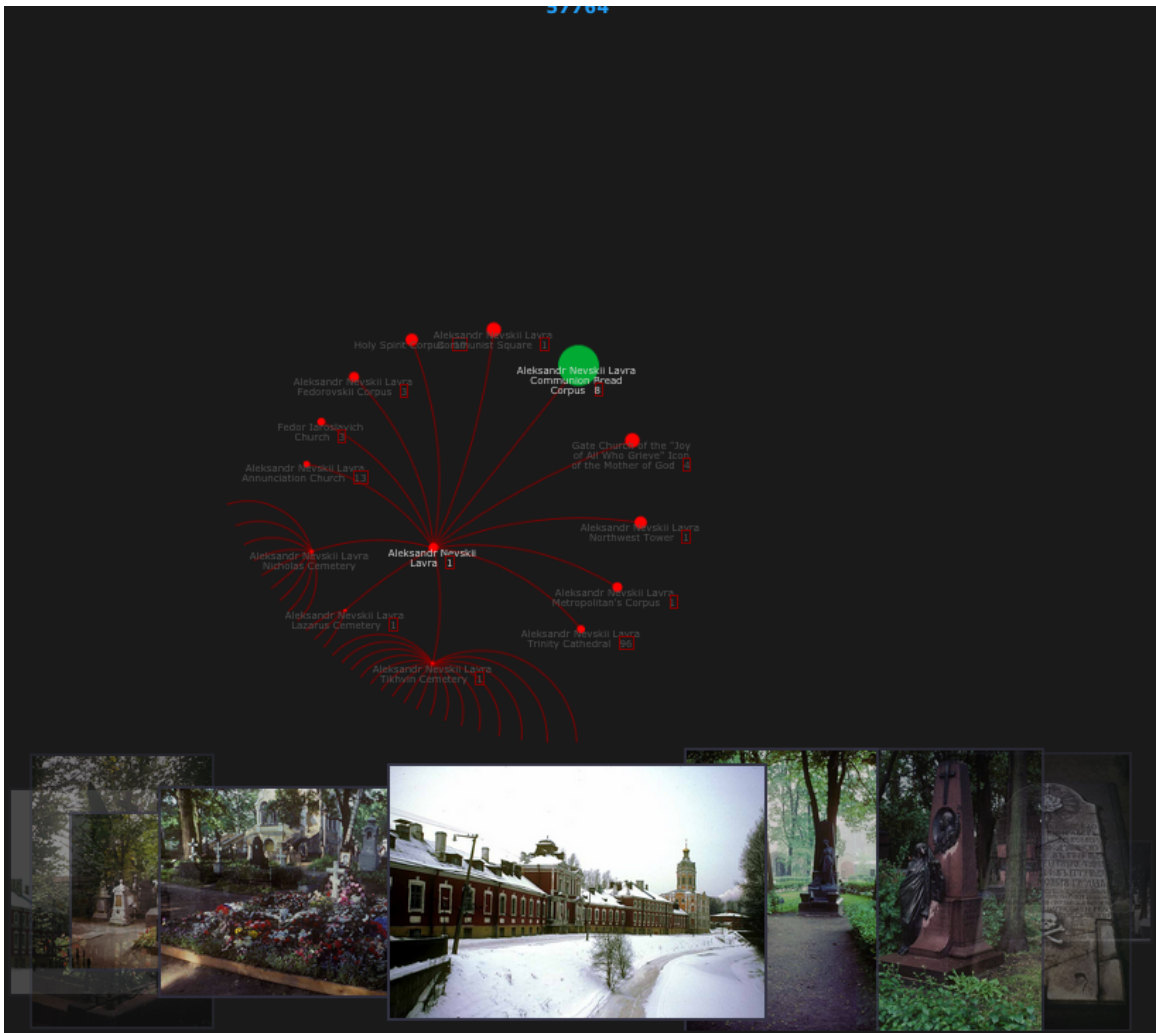


Figure 2: Clicking the green “Communion break corpus” node centers it.

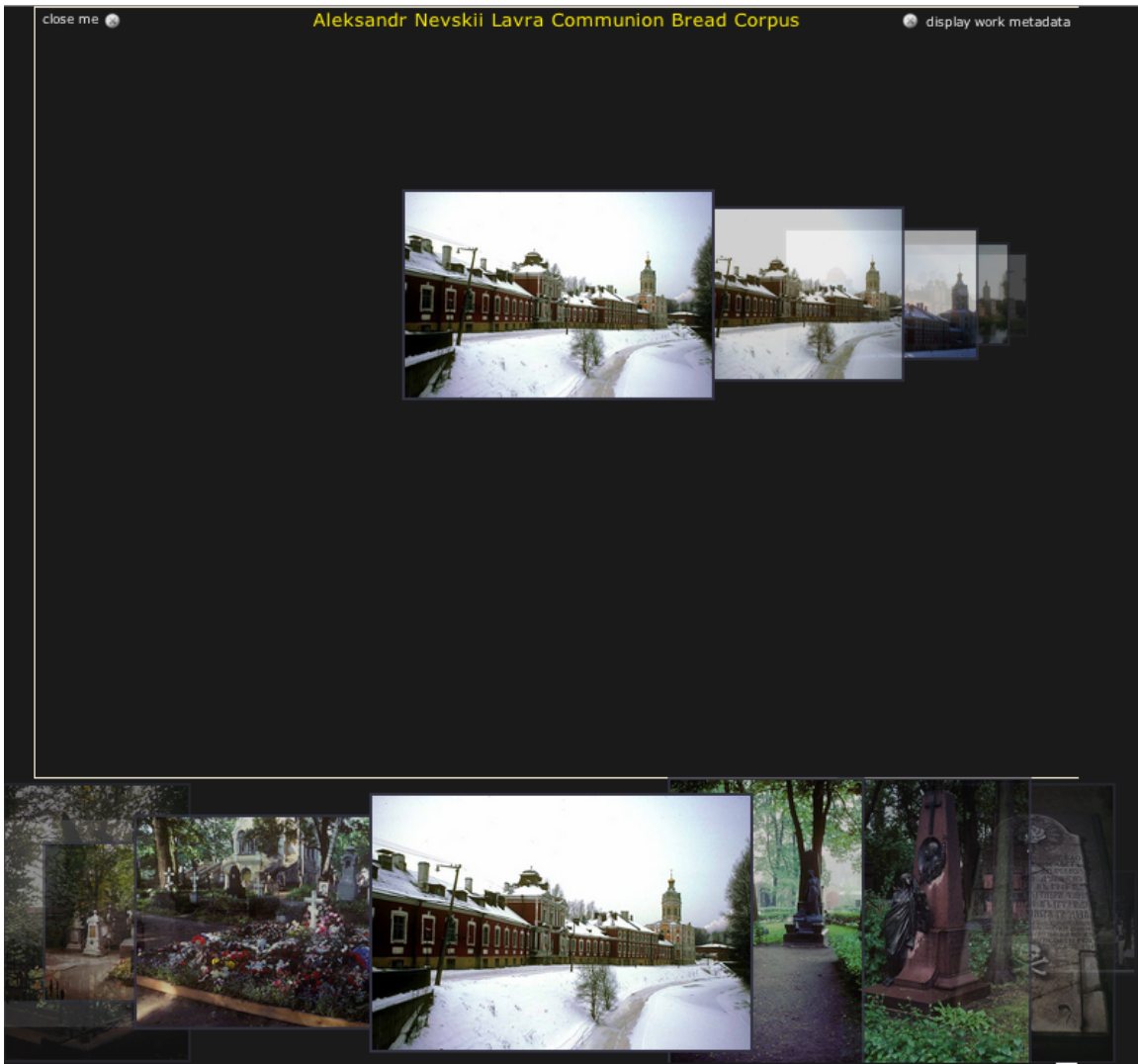


Figure 3: Carousel of images associated with the green Communion Bread Corpus node in Figure 2, resulting from right clicking that node.

close me Aleksandr Nevskii Lavra Communion Bread Corpus hide work metadata

```
"subjects": [
  "religious complexes (AAT)"
],
"location": {
  "city": "Saint Petersburg",
  "country": "Russia (Federation)",
  "raion": null,
  "oblast": "Leningradskaia oblast",
  "address": null,
  "location_type": "site"
},
"date": [
  {
    "date_type": "creation",
    "date_begin": "1740",
    "date_end": "1774",
    "date_display": "1740-1774"
  }
],
"creators": [
  {
    "role": "architect",
    "name": "Rossi, I.L."
  },
  {
    "role": "architect",
    "name": "Trezzini, P.A."
  },
  {
    "role": "architect",
    "name": "Rastorguev, Mikhail Dmitrievich"
  }
]
```

Figure 4: Clicking the “display work metadata” link shows the work metadata associated with the Communion Bread Corpus node.



Figure 5: Clicking on an image in the carousel of images in the previous Figure presents a larger view of that image in a modal dialog.

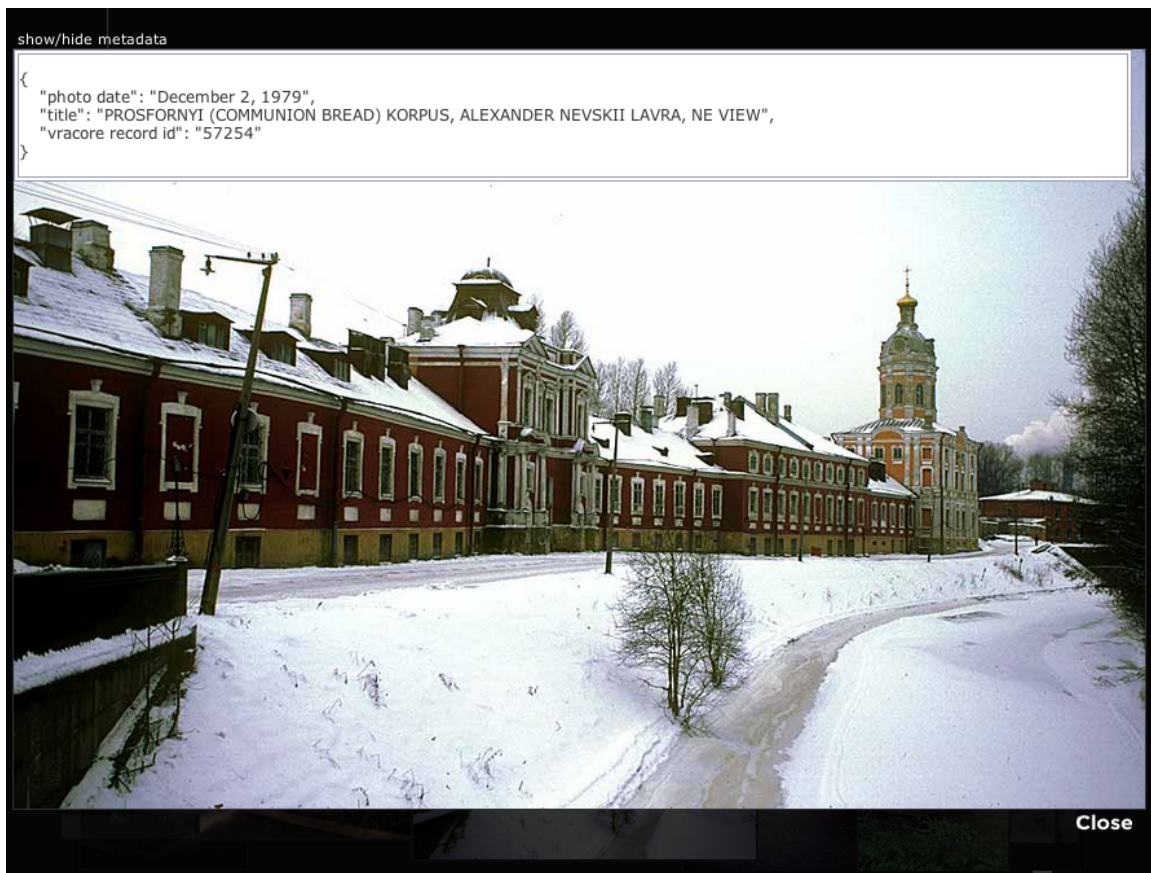


Figure 6: Clicking the “show/hide metadata” link displays the metadata associated with the currently displayed image.

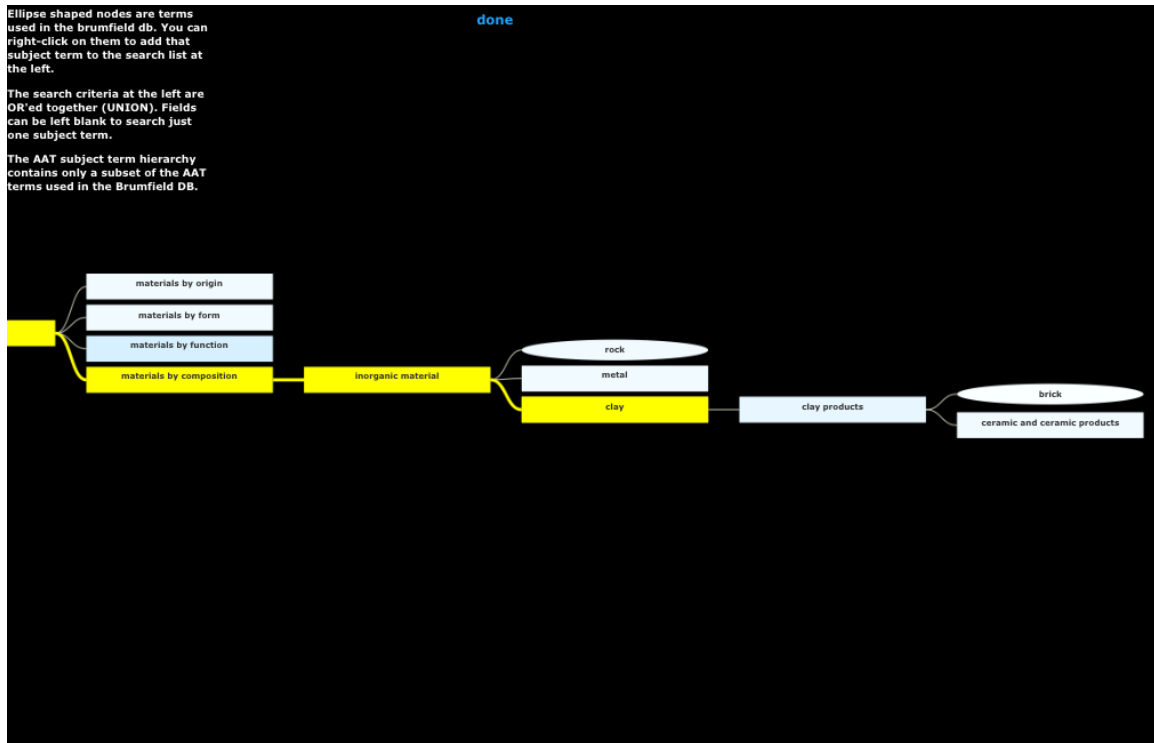


Figure 7: “Spacetree” display of a portion of the Getty AAT’s “Materials” facet. The ellipse indicates that the term is used in the Brumfield database.

Endnotes

¹ Art & Architecture Thesaurus (AAT). Getty Vocabulary Program. Los Angeles: J. Paul Getty Trust, Vocabulary Program, 1988-.

² ImageFlow v. 1.3.0 for carousel image display, available from <http://imageflow.finnrudolph.de>

³ jQuery toolkit v. 1.4.2 for JavaScript DOM manipulation, available from <http://jquery.com>

⁴ JavaScript InfoVis Toolkit v. 2.0.1 for tree and graph representations, available from <http://thejit.org>

⁵ Shadowbox v. 3.0.3 for modal image display, available from <http://shadowbox-js.com>